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# TECHNICAL MEMORANDUM REGARDING FACILITY-WIDE GROUNDWATER RECLASSIFICATION NSTC GREAT LAKES IL

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**TECHNICAL MEMORANDUM**
**FACILTY-WIDE GROUNDWATER RECLASSIFICATION**
**NAVAL STATION GREAT LAKES, GREAT LAKES, ILLINOIS**
**SEPTEMBER 2013**

This technical memorandum evaluates the shallow groundwater conditions at Naval Station Great Lakes (NSGL) with respect to the Illinois Environmental Protection Agency (Illinois EPA) classification of potable groundwater. Shallow groundwater at NSGL refers to groundwater contained in Quaternary sediments of glacial and post-glacial origin overlying the Silurian bedrock within the facility boundaries of NSGL and situated on the level plain atop the bluff west of the shoreline along Lake Michigan at elevations of approximately 650 feet or higher. Groundwater in the State of Illinois is classified as Class I: Potable Resource Groundwater, unless there is reason for reclassification. Information gathered during environmental investigations at NSGL has called into question the classification of shallow groundwater as Class I.

## 1.0 FACILITY DESCRIPTION

NSGL is located in Great Lakes, Lake County, Illinois, along the shore of Lake Michigan and approximately 30 miles north of Chicago (Figure 1). It is bounded on the north by the City of North Chicago, on the south by the Veterans Administration Hospital and Shore Acres Golf Course and Country Club, on the east by Lake Michigan, and on the west by U.S. Route 41 (Skokie Highway). The activities at NSGL support Naval training and consist of the Recruit Training Command, Training Support Center, and Naval Facilities Engineering Command Midwest.

## 2.0 REGULATORY FRAMEWORK

Groundwater in the State of Illinois is designated as one of four classifications: Class I: Potable Resource Groundwater, Class II: General Resource Groundwater, Class III: Special Resource Groundwater, or Class IV: Other Groundwater. The Illinois Groundwater Protection Act (Title 35, Subtitle F, Chapter I, Part 620, Subpart B, Section 620.210) defines Class I: Potable Resource Groundwater as:

"a) Groundwater located 10 feet or more below the land surface and within:

1) The minimum setback zone of a well which serves as a potable water supply and to the bottom of such well;

2) Unconsolidated sand, gravel or sand and gravel which is 5 feet or more in thickness and that contains 12 percent or less of fines (i.e. fines which pass through a No. 200 sieve tested according to ASTM Standard Practice D2488-84, incorporated by reference at Section 620.125);

3) Sandstone which is 10 feet or more in thickness, or fractured carbonate which is 15 feet or more in thickness; or

4) Any geologic material which is capable of a:
   A) Sustained groundwater yield, from up to a 12 inch borehole, of 150 gallons per day or more from a thickness of 15 feet or less; or
   B) Hydraulic conductivity of 1 x $10^{-4}$ cm/sec or greater using one of the following test methods or its equivalent:
      i) Permeameter;
      ii) Slug test; or
      iii) Pump test.

b) Any groundwater which is determined by the Illinois Pollution Board pursuant to petition procedures set forth in Section 620.260, to be capable of potable use."

Class II: General Resource Groundwater (Section 620.220) refers to groundwater that does not meet the provisions of Class I, III (Section 620.230), or IV (Section 620.240) and is found by the Illinois Pollution Control Board to be capable of agricultural, industrial, recreational, or other beneficial uses. (Class III: Special Resource Groundwater is groundwater determined by the Illinois Pollution Control Board to be demonstrably unique and suitable for application of a water quality standard more stringent than the otherwise applicable water quality standard or vital for a particularly sensitive ecological system, or contributes to a nature preserve dedicated pursuant to the Illinois Natural Areas Preservation Act. Class IV: Other Groundwater is groundwater:

a) Within a zone of attenuation as provided in 35 Illinois Administrative Code (IAC) 811 and 814;
b) Within a point of compliance as provided in 35 IAC 724;
c) That naturally contains more than 10,000 milligrams per liter of total dissolved solids;
d) Which has been designated by the Illinois Pollution Control Board as an exempt aquifer pursuant to 35 IAC 730.104;
e) Which underlies a potential primary or secondary source, in which contaminants may be present from a release;
f) Which underlies a coal mine refuse disposal area not contained within an area from which overburden has been removed, a coal combustion waste disposal area at a surface coal mine, or an impoundment that contains sludge, slurry, or precipitated process material at a coal preparation plant, in which contaminants may be present; or
g) Within a previously mined area.)

Unless otherwise proven not to meet the requirements set forth in the Illinois Groundwater Protection Act, all groundwater in the State of Illinois is considered Class I. The shallow groundwater at NSGL (with the exception of one area classified as Class II as discussed below) is considered to be Class I.

Former waste sites at NSGL have been identified and are or have been investigated and remediated under the Department of the Navy's Installation Restoration Program. The comprehensive environmental investigation and cleanup program at NSGL is being conducted under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 and the Superfund Amendments and Reauthorization Act (SARA) of 1986. Sites identified at NSGL that are currently or have previously been investigated and which are discussed in this evaluation are shown on Figure 1. The lead regulatory agency overseeing cleanup activities at NSGL is the Illinois EPA.

## 3.0 GEOLOGY AND HYDROGEOLOGY

Several studies have characterized the shallow hydrogeology of the area north of Chicago, which includes NSGL. In addition, multiple subsurface investigations have been performed at NSGL, providing information on the geology and hydrogeology at the facility. A summary of the

geologic and hydrogeologic conditions of the NSGL area, along with facility-specific conditions, is provided in the following subsections.

## 3.1 GEOLOGY

The main portion of NSGL is situated on level plain at an elevation of approximately 650 feet atop a steep bluff that rises 70 feet above the beach along Lake Michigan (Figure 2). NSGL lies within the Wheaton Morainal Country subsection of the Great Lake Section of the Central Lowland Physiographic Province of Illinois. The Wheaton Morainal Country subsection is characterized by hilly topography, broad parallel morainic ridges, lakes, and swamps (Suter et al., 1959).

NSGL lies within the Lake Border Morainic System, with the Highland Park Moraine trending north-northwest through the western portion of NSGL. (Green Bay Road generally follows the ridge of the Highland Park Moraine.) The surficial geology of the NSGL area consists primarily of glacial and post-glacial sediments overlying Silurian-age bedrock. Sediment thicknesses range from 120 to 230 feet. The surficial geology in the area of NSGL is mapped mainly as the Wadsworth Formation, with north-northwest trending bands, 100 to 300 feet wide, of the Equality Formation (Figure 2). The Wadsworth Formation is described as a diamicton of silty clay loam to silty clay with occasional cobbles and boulders. Lenses of saturated silt and very fine sand may be present. The Wadsworth Formation was formed by subglacial and ice marginal sediments (till) that were deposited from glacial ice. The bands of the Equality Formation occur as thin layers overlying the Wadsworth Formation. The Equality Formation is described as massive to bedded silt, clay, and sand and is interpreted as being deposited by glacial and post-glacial proglacial lakes that infilled low-lying areas or depressions in drainage channels and where water was impounded behind moraines (Barnhardt, 2010).

A technical memorandum for the remedial investigation (RI) verification step (NEESA, 1991) described the till at NSGL as (underlining added):

> "In general, the till at NTC Great Lakes is highly clayey with thin - <u>often less than 2 feet thick - irregular lenses of sand and silty sand occurring over limited areas</u>. These small lenses or pockets of sandy material may have been placed during minor changes in the movement of the ice sheet (i.e., a brief thaw producing

some fluvial deposition) or as a result of variations in the ice sheet itself (such as a small crevasse resulting in deposition of coarser material). Regardless of the source of these coarser deposits, the significance of their presence is that they [sand lenses] are discontinuous and have only limited areal extent."

## 3.2 GROUNDWATER USE

Water wells for domestic, industrial, or municipal use in northeastern Illinois typically draw from the uppermost Silurian-age dolomite, but locally wells have been completed in sand and gravel units immediately above bedrock or in the bedrock (Woller and Gibb, 1976). In contrast, the thin, discontinuous stringers of sand within the till offer the poorest potential for groundwater use, due to the low hydraulic conductivity of the till and the absence of widespread sand and gravel beds (Bergstrom et al, 1955). A geologic report by the Illinois Geological Survey for potential groundwater possibilities for a site adjacent to and in the vicinity of NSGL (Illinois State Geological Survey, 1950) reported (underlining added) the following:

"The limestone bedrock SE ¼, SE ¼ of Sec[tion] 5 is mantled with unconsolidated glacial drift. Depth to the bedrock in this immediate area could be expected to range from about 135 to 155 feet, with the greater drift thicknesses occurring beneath the extreme east portion of Sec[tion] 5. The drift mantle is composed principally of silt and pebbly clay of insufficient permeability to allow free groundwater movement. Although water-bearing sands do occur within the drift mantle in this area, these deposits are not abundant nor extensive enough here to be considered highly favorable sources of groundwater. The unconsolidated sand and gravel deposits which are encountered in test borings in the North Chicago area are generally discovered in the basal portion of the drift within 10 to 35 feet of the bedrock surface."

## 3.3 FACILITY-SPECIFIC HYDROGEOLOGY

The geologic and hydrogeologic information summarized in the following subsections was obtained from multiple investigations conducted in support of environmental and non-environmental engineering projects at NSGL.

### 3.3.1 Facility-Wide Information

Facility-wide studies and plans have discussed the hydrogeology of and groundwater use within NSGL. The Initial Assessment Study (Rodgers, Golden, and Halpern, 1986) for NSGL described the clayey and very low permeability unconsolidated material at NSGL as follows:

> "Unconsolidated glacial tills blanket Lake County...Naval Station Great Lakes falls within both the Lake Border and Zion City moraine systems...These glacial moraine systems are composed of Wadsworth till, which constitutes the largest volume of surficial deposits overlying the bedrock."
>
> "The Wadsworth till ranges from approximately 170 to 210 feet in thickness overlying the Silurian limestone bedrock. This till is an unsorted mixture of sand, silt, and clay imbedded with pebbles, cobbles, and boulders. Interstices between the coarser-grained sediments are typically filled with fine, clay-sized particles. Consequently, the till can be practically impermeable to water. Hydraulic conductivities for clayey tills may be 10 to the minus 12 centimeters per second (cm/sec), meaning that water may only migrate 10 meters through the till in 10,000 years (Freeze and Cherry, 1979)."
>
> "Although till is the dominant type of glacial deposit in the Naval Station Great Lakes area, well logs show localized sorted volumes of discontinuous sand stringers and lenses throughout the till. The till has been further subdivided into clayey and sandy phases according to the size of the dominant particles. Because clay comprises up to 70 percent of the till at Naval Station Great Lakes, the clayey phase dominates in the local area."

The Community Relations Plan for NSGL (PWC/EFA Environmental Office, 1996) describes potential use of groundwater at NSGL as follows:

> "Groundwater occurs throughout the till [Wadsworth] but the till yields very little water and does not constitute an aquifer. The discontinuous lenses and strands of sandy materials are potential sources of groundwater. However, due to their limited extent and irregular nature, the quantity of water available from these

deposits is limited and there is no indication that they provide more than minor water supplies. Most wells in the area tap bedrock as the source of groundwater. The source of drinking water for NTC Great Lakes is Lake Michigan. Groundwater is not used as a drinking water source at NTC Great Lakes. In general, the potential for contaminant migrations in the till is very low because of the low hydraulic conductivity and rate of groundwater flow."

### 3.3.2 Site-Specific Information

Multiple individual site investigations have been conducted as part of the environmental investigation and cleanup program at NSGL. Figure 1 presents the environmental sites within NSGL. As part of these investigations, soil borings have been advanced and monitoring wells have been installed to collect soil and groundwater samples for laboratory analysis to characterize the soil and groundwater at potentially contaminated sites. In addition, in-situ hydraulic conductivity tests (i.e., slug tests) have typically been conducted in monitoring wells during RIs to estimate bulk hydraulic conductivity. Among the environmental sites investigated include Sites 1 (Golf Course Landfill), 2 (Forrestal Landfill), 3 (Supplyside Landfill), 4 (Fire Fighting Training Unit), 5 (Transformer Storage Boneyard), 7 (RTC Silk Screening Shop), 9 (Camp Moffett Ravine Fill Area), 19 (Former Small Arms Range 910), 21 (Building 1517/1506 Area), and 22 (Building 105 – Old Dry Cleaning Facility) and the former gasoline station site at Building 1600A. In addition, a study was conducted in 1990 to evaluate groundwater conditions and its effect on steam manholes and lines. The areas investigated under this study were identified as Mainside, Forrestal Village, and Halsey Village.

A brief description of the hydrogeologic conditions at these sites follows. The descriptions provide information related to the requirements of Title 35, Subtitle F, Chapter I, Part 620, Subpart B, Section 620.210 (2) and (4). Table 1 summarizes the hydraulic conductivity values for sites at NSGL.

**Site 1 – Golf Course Landfill**

Site 1 is located in the northwestern part of the NSGL (Figures 1 and 3). For the RI (Tetra Tech NUS, 2008a), 103 borings were advanced throughout Site 1, to depths ranging from 8 to 40 feet below ground surface (bgs). Monitoring wells were installed in 14 borings, of which 10 were

permanent installations and four were temporary. Soil boring logs at Site 1 indicated that shallow subsurface lithology to a depth of 40 feet consists predominately of brown silty clay grading to blue-gray clay with infrequent sand and gravel layers. Seven of 10 permanent wells at Site 1 had slug tests performed in them (NTC01MW01, NTC01MW02, NTC01MW04, NTC01MW05, NTC01MW07, NTC01MW08, and NTC01MW10).

Of the 103 soil borings advanced as part of the RI, only one well (NTC01MW10) had a zone of 5 feet or more of unconsolidated sand below 10 feet bgs.

For seven soil samples from Site 1, the percentages of material passing the No. 200 sieve ranged from 24.5 to 85.5. The Unified Soil Classification System descriptions of these soils ranged from SC (clayey sand) to CL (silty clay).

The geometric mean of hydraulic conductivities for Site 1 was $3.74 \times 10^{-4}$ cm/sec; however, the geometric mean of hydraulic conductivity values is not considered representative of the entire 130-acre site. Of the 103 soil borings advanced as part of the RI, 33 borings were observed to be dry. Wells installed as part of the RI were installed in borings with observed saturated zones, primarily within shallow, thin sand stringers with average thicknesses of 2 feet. These sand stringers were observed to be laterally discontinuous. In addition, three wells (NTC01MW01, NTC01MW05, and NTC01MW08) had shallow screens (installed at 15 feet bgs or less) and sand zones at or shallower than 10 feet bgs. Overall, the geometric mean hydraulic conductivity value for Site 1 is skewed toward the sand zones of higher permeability, which are generally thin and discontinuous, and does not represent the overall overburden thickness.

The Site 1 RI reported that "The shallow aquifer ranges from 0.5 to 40 feet bgs [below ground surface] and is composed primarily of unconsolidated silty clays to clays and minor silts with discontinuous sand and gravel lenses interspersed throughout...In general, the water table within these heterogeneous deposits is shallow and was typically encountered at depths ranging from 1 to 17 feet bgs at the site. Groundwater can be expected to migrate laterally through the more permeable materials present within the silty clays and clays. At many soil boring locations, even locations reaching 40 feet bgs, no water was encountered even when sand and gravel lenses were encountered. Additionally, many soil borings did not contain sand and gravel lenses and were subsequently dry. Therefore, the shallow water table aquifer is assumed to be discontinuous across the site."

**Site 2 – Forrestal Landfill**

Site 2 is located in the southwestern part of the NSGL (Figures 1 and 3). Six borings were drilled in May 2006 for monitoring well installation for long-term monitoring at the site. The wells were installed to depths of 50 feet bgs with 40-foot screens (TolTest, 2007). Three wells at Site 2 had slug tests performed in them (Tetra Tech NUS, 2008b).

Soil borings at Forrestal Landfill noted predominately clay and silt. None of the wells had 5 feet or greater thicknesses of unconsolidated sand or gravel below 10 feet bgs. Zones of moisture (moist to wet) were noted at varying depths in the borings, indicating discontinuous saturated zones.

The geometric mean hydraulic conductivity value for Site 2 was $1.08 \times 10^{-5}$ cm/sec, less than the requirements for a Class I Groundwater. None of the wells at Site 2 had a hydraulic conductivity greater than $1 \times 10^{-4}$ cm/sec; the maximum hydraulic conductivity was $6.87 \times 10^{-5}$ cm/sec.

**Site 3 – Supplyside Landfill**

Site 3 is located in the southwestern part of the NSGL, south of Site 2 (Figures 1 and 3). Six borings were drilled and six monitoring wells were installed in May 2006 for long-term monitoring at the site. The wells were installed to a depth of 50 feet bgs with 40-foot screens (TolTest, 2007).

The material encountered in the borings at Supplyside Landfill was similar to material encountered at Forrestal Landfill, predominantly clay and silt. The soil borings indicate that five of the wells had no unconsolidated sand or gravel greater than 5 feet in thickness below 10 feet bgs. In one well boring, SL-05, silty sand was noted from 15 to 20 feet bgs; however, because soil cuttings only were logged during drilling of well borings the actual thickness of the sand is not considered accurate.

Slug tests were performed in three of the six wells at Site 3. The geometric mean hydraulic conductivity value at Site 3 was $8.16 \times 10^{-4}$ cm/sec. One well (SL-02) reportedly yielded no

water after two days, qualifying it as a "dry" well (TolTest, 2007). During long-term monitoring by Tetra Tech, there was standing water in SL-02, but the yields were low during purging for sampling. Purge rates were 100 milliliters per minute or less, and water level drops during purging were generally equivalent to the volume of water purged indicating the yield from these wells was quite low.

**Site 4 – Fire Fighting Training Unit**

Site 4 is located within Site 1, located in the northwestern part of the NSGL (Figures 1 and 3). Twenty-one monitoring wells were installed. Seventeen wells were installed to depths of 16 feet bgs or less, and four wells were installed to depths between 33 to 47 feet bgs as part of the RI at Site 4 (Belinger Consultants, 1998).

The material encountered in the borings was sandy fill to depths of 8 to 16 feet, depending on location. Below the fill material, diamicton (Wadsworth Formation) was identified. Cone penetrometer tests (CPTs) were conducted to depths of 50 to 75 feet bgs at Site 4. CPTs results indicated sandy fill material to an average depth of approximately 15 feet, underlain by hard clay till or diamicton (Wadsworth Formation). Sand layers or sandy silt layers were observed between 33 and 47 feet, with diamicton below from 45 feet to 70 feet bgs. (Information was not provided in the RI Report regarding the thicknesses of the sand or sandy silt layers.) Most of the CPTs encountered refusal at approximately 70 to 75 feet on a hard gravel unit overlying bedrock. The Site 4 RI report stated, "The diamicton units are relatively impermeable."

Grain size analysis was performed for seven soil samples from Site 4. Of the seven samples, three samples were from approximately 10 feet bgs or less and are excluded from this evaluation. The remaining four samples were collected from the diamicton unit, the sandy layers at 37 to 44 feet, or the interface between the diamicton and sandy layers. The percentages of material in the samples passing the No. 200 sieve ranged from 13.5 to 95.8. The Unified Soil Classification System descriptions of these soils ranged from CL (clayey sand) to SM (silty sand).

Slug tests were performed in two of the shallows wells at Site 4, and the geometric mean hydraulic conductivity value at Site 4 was $5.25 \times 10^{-5}$ cm/sec. However, the two wells in which

slug tests were performed had 10-foot screens placed in fill material, at total depths of 12 and 16 feet bgs. Therefore, the hydraulic conductivity for Site 4 is not considered representative of the material below 10 feet and was not included in calculation of the facility-wide geometric mean in Table 1.

**Site 5 – Transformer Storage Boneyard**

Site 5 is located in the north-central portion of NSGL (Figures 1 and 3). Twenty-four borings were drilled at Site 5 to depths ranging from 10 to 40 feet, of which five were converted to permanent monitoring wells (Tetra Tech, 2013b).

The shallow subsurface lithology at Site 5 below 10 feet bgs was described as a fat clay to at least 40 feet bgs. Thin, discontinuous sand seams of less than 1 foot were observed in two borings.

Slug tests were performed in four monitoring wells at Site 5: NTC05MW01, NTC05MW03, NTC07MW04, and NTC07MW05. The geometric mean of hydraulic conductivity at Site 5 was $9.77 \times 10^{-4}$ cm/sec.

**Site 7 – RTC Silk Screening Shop**

Site 7 is located in the central portion of NSGL (Figures 1 and 3). Seventeen borings were drilled within Site 7 ranging from 8 to 24 feet bgs, of which eight were converted to permanent monitoring wells (Tetra Tech NUS, 2003). One well was dry after installation (NTC07MW04) and was abandoned.

The shallow subsurface lithology at Site 7 was described as a heterogeneous mixture of sandy clays, gravelly clays, and silty clays with discontinuous sand stringers to a depth of 24 feet bgs. None of the borings identified sand or gravel zones greater than 5 feet thick below 10 feet bgs; clay with varying amounts of silt and sand (i.e., diamicton) was encountered below 10 feet bgs. Grain size analysis of three soil samples indicated that 62.3 to 83.9 percent of material passed the No. 200 sieve. The Unified Soil Classification System (USCS) descriptions of these soils ranged from ML (sandy silt) to CL (silty clay). However, the samples for grain size analysis

were from shallow intervals of 1 to 12 feet bgs and therefore mainly represent soil from depths less than 10 feet.

Six monitoring wells at Site 7 had slug tests performed in them (NTC07MW01, NTC07MW02, NTC07MW05, NTC07MW06, NTC07MW07, and NTC07MW08). The geometric mean hydraulic conductivity value at Site 7 was $8.19 \times 10^{-5}$ cm/sec.

**Site 9 – Camp Moffett Ravine Fill Area**

Site 9 is located in the north-central portion of NSGL (Figures 1 and 3). As part of the RI for Site 9, 21 soil borings were drilled to depths ranging from 8 to 20 feet bgs (Tetra Tech, 2013a). Eight monitoring wells were installed as part of the RI. Generally, sandy fill material was encountered to depths of 3 to 8 feet bgs and was underlain by diamicton (silt and clay). Sand fill with some debris was encountered in one boring to 18 feet bgs. Sandy layers below 10 feet bgs were encountered in nine borings and were typically 1 to 3 feet thick. One boring (NTC09SB14) had a 6-foot-thick sand layer at 13 to 19 feet bgs. The sand layers at Site 9 were laterally discontinuous.

Two soil samples from depths below 10 feet were analyzed for grain size, and 55 and 56 percent of the material passed the No. 200 sieve. The USCS descriptions of these soils ranged from SM (silty sand) to SM/SC (silty/clayey sand).

Slug tests were performed in four monitoring wells at Site 9. The geometric mean hydraulic conductivity value for Site 9 was $4.10 \times 10^{-4}$ cm/sec, slightly greater than $1 \times 10^{-4}$ cm/sec.

**Site 19 – Former Small Arms Range 910**

Site 19 is located in the south-central area of NSGL (Figures 1 and 3). Twenty soil borings were drilled for the RI at Site 19 to depths ranging from 12 to 40 feet bgs. The shallow subsurface lithology to 40 feet bgs was predominantly silty clay grading to clay with occasional discontinuous lenses of gravel, sand, or silt (Tetra Tech NUS, 2010). Sand was observed in two borings (NTC19SB06 and NTC19SB07) from approximately 3 feet bgs to the total depth of the borings (12 feet bgs). Sand lenses at least 5 feet thick were observed in three other borings, but the sand was shallower than 10 feet bgs.

Grain size analysis was performed for three soil samples; however, the samples were from depths shallower than 10 feet bgs and are not considered for this evaluation.

Six monitoring wells were proposed at Site 19; however, after placing temporary wells at seven locations to depths up to 40 feet bgs, only two wells produced water after two days. Dense clay was observed in the other well borings to depths of 30 to 40 feet bgs.

Hydraulic conductivity was measured at well NTC19MW01. The other well was not tested for its hydraulic conductivity because it went dry during well development. The hydraulic conductivity of NTC19MW01 was $6.31 \times 10^{-4}$ cm/sec. Although the hydraulic conductivity of NTC19MW01 is slightly greater than $1 \times 10^{-4}$ cm/sec, the five other borings proposed for well installation did not produce groundwater, indicating that the mean bulk hydraulic conductivity of Site 19 is lower than that measured in NTC19MW01.

**Site 21 – Building 1517/1506 Area**

Site 21 is located in the north-central part of NSGL (Figures 1 and 3). Twenty-two soil borings were drilled at Site 21, to depths ranging from 4 to 28 feet bgs (Tetra Tech, 2012a). Six of the borings were converted to monitoring wells. With the exception of the southwestern portion of Site 21, most of Site 21 has a layer of fill material below the asphalt/grassy top to a depth of 1 to 5 feet bgs. Typically, the fill is a sand, gravelly sand, and/or silty sand with areas of coal, ash, slag, brick fragments, etc. Below the fill material is a natural clay/silt unit (diamicton) observed to at least 28 feet bgs.

Grain size analysis was performed for one soil sample from Site 21; however, the sample was from a depth shallower than 10 feet bgs and therefore is not considered for this evaluation.

Slug tests were performed in four wells at Site 21: NTC21MW01, NTC21MW02, NTC21MW05, and NTC21MW06. The geometric mean hydraulic conductivity value at Site 21 is $2.73 \times 10^{-4}$ cm/sec.

## Site 22 – Old Dry Cleaner Facility

Site 22 is located in the northeastern portion of NSGL (Figures 1 and 3). Twenty soil borings were drilled at Site 22 to depths ranging from 12 to 50 feet bgs. Thirteen of the borings were converted to monitoring wells. The shallow subsurface lithology consists of up to approximately 5 feet of fill material underlain by a heterogeneous mixture of sandy clays, gravelly clays, and silty clays with discontinuous silt and sand stringers to a depth of 30 feet bgs. A fine- to coarse-grained sand layer is present between 28 to 40 feet bgs, varying in thickness from 6 to 8 feet. This layer appears laterally extensive across much of the site. Four wells (NTC22MW06S, NTC22MW06D, NTC22MW10S, and NTC22MW10D) are screened within this zone. Below the sand layer is clay and silty clay to at least 50 feet bgs (Tetra Tech NUS, 2004).

Six soil samples from depths below 10 feet were analyzed for grain size, with 24.5 to 87.9 percent of the material passing the No. 200 sieve. The USCS descriptions of these soils ranged from SM (silty sand) to CL (clay).

Slug tests were performed on nine wells at Site 22 (NTC22MW01S, NTC22MW02S, NTC22MW03S, NTC22MW05S, NTC22MW07S, NTC22MW07D, NTC22MW08S, NTC22MW10S, and NTC22MW10D). The geometric mean hydraulic conductivity value at Site 22 was $2.13 \times 10^{-4}$ cm/sec. Two wells (NTC22MW10S and NTC22MW10D) had hydraulic conductivities of $1.63 \times 10^{-2}$ and $4.46 \times 10^{-2}$ cm/sec, respectively. These wells were screened within the sand zone between 32 and 40 feet bgs.

## Mainside, Forrestal Village, and Halsey Village

Mainside, Forrestal Village, and Halsey Village are three of the eight subareas of NSGL, designated in the Underground Water Table Investigation and Study (RJN Environmental Associates, 1990). Their general locations are coincident with piezometers P-82 and P-85 (Mainside), P-91 (Forrestal Village), and P-72 (Halsey Village) on Figure 3. These areas are not environmental sites but rather developed areas of NSGL, encompassing several hundred acres. The piezometers identified were selected for inclusion in this evaluation because: (1) the depths of the piezometers were greater than 10 feet and (2) they provide better spatial coverage across NSGL. The piezometers in the Mainside area were advanced to 13 feet (P-82), 12.5 feet (P-85), and 20 feet (P-88) bgs. The piezometers installed in Halsey Village (P-72) and Forrestal

Village (P-91) were installed to 13 and 20 feet bgs, respectively. In the Mainside, silty clay was encountered at locations P-82 and P-85; sand was encountered in the bottom 2.5 feet of P-82. Sand with silt was encountered from 10 feet to the bottom of the boring (20 feet bgs) at P-88. In Halsey Village, silty clay was encountered to the bottom of the boring. In Forrestal Village, silty clay was encountered below 10 feet bgs, with two sand and gravel seams less than 1 foot thick at 10 and 13 feet bgs.

Soil samples from depths below 10 feet from P-82 and P-88 were analyzed for grain size. Based on the graphs in the report (RJN Environmental Associates, 1990), 23 and 38 percent respectively, of the material in the samples passed the No. 200 sieve.

Slug tests were performed in the five piezometers. The geometric mean hydraulic conductivity values were $1.07 \times 10^{-6}$ cm/sec for the Mainside, $2.03 \times 10^{-7}$ for Halsey Village, and $2.24 \times 10^{-6}$ for Forrestal Village.

**UST Site 5 – Old Gas Station, Building 1600A**

Underground storage tank (UST) Site 5 is located in the north-central portion of NSGL (Figures 1 and 3). In 2009, TolTest, on behalf of NSGL, requested a review by Illinois EPA for a determination in the reclassification of groundwater at UST Site 5 from Class I to Class II (LES/TolTest, 2009). In the request, estimated daily yield and slug tests data were presented. Based on purge data, daily yields were estimated to be between 85 to 114 gallons per day, which is less than the 150 gallons per day specified in 35 IAC Part 620.210(a)(4)(A) for Class I groundwater. The average hydraulic conductivity from nine wells at UST Site 5 was calculated to be $9.14 \times 10^{-5}$ cm/sec.

The review concluded that groundwater at UST Site 5 did not meet the definition of Class I: Potable Resource Groundwater. In August 2009, Illinois EPA agreed and approved the reclassification of groundwater at Site 5 from Class I: Potable Resource Groundwater to Class II: General Resource Groundwater (Illinois EPA, 2009).

## 4.0 POTABLE RESOURCE GROUNDWATER REQUIREMENTS AND GROUNDWATER AT NSGL

Class I: Potable Resource applies to groundwater located 10 feet or more below the land surface, as specified under 35 IAC Part 620.210(a), or any groundwater determined by the Illinois Pollution Board, pursuant to petition procedures set forth in Section 620.260, to be capable of potable use, as specified under 35 IAC Part 620.210(b). Groundwater at NSGL has not been reclassified under 35 IAC Part 620.210(b). The following subsections present an evaluation of the requirements for potable groundwater under 35 IAC Part 620.210(a) with respect to shallow groundwater at NSGL.

### 4.1 35 IAC PART 620.210(a)(1) – SETBACK ZONE

Per 35 IAC Part 620.210(a)(1), Class I: Potable Resource Groundwater is groundwater 10 feet or more below the land surface and within "The minimum setback zone of a well which serves as a potable water supply and to the bottom of such well." Attachment A includes a map of the NSGL area from the Illinois EPA resource management mapping service (Illinois EPA, 2013). The closest community supply wells to NSGL (Arden Shores, Strawberry, and Whispering Lakes) have setback zones of 200 feet. These wells are set in bedrock. No well setback zones are within the area of NSGL in the map. Therefore, this requirement is not met for shallow groundwater at NSGL to be classified as Class I.

### 4.2 35 IAC PART 620.210(a)(2) – SAND AND GRAVEL

Per 35 IAC Part 620.210(a)(2), Class I: Potable Resource Groundwater is groundwater 10 feet or more below the land surface and within "Unconsolidated sand, gravel or sand and gravel which is 5 feet or more in thickness and that contains 12 percent or less of fines (i.e. fines which pass through a No. 200 sieve tested according to ASTM Standard Practice D2488-84, incorporated by reference at Section 620.125)." NSGL is underlain mainly by the Wadsworth Formation, diamicton consisting of silty clay loam to silty clay with occasional discontinuous stringers of silt and sand. Portions of NSGL are underlain by the Equality Formation, which is massive to bedded silt, clay, and sand. Based on lithologic information from borings at NSGL, subsurface materials below 10 feet bgs are primarily silty clay to clay to depths of at least 70 feet bgs. Below 70 feet is either gravelly till or bedrock. Sand lenses with thicknesses of 5 feet

or greater have been identified in borings at the facility; however, these sandy zones are isolated and laterally discontinuous. It is estimated that the sand lenses encountered in the diamicton are on average less than 2 feet thick. Furthermore, grain size analyses indicate that the percentages of fines passing a No. 200 sieve are greater than 12 percent. Therefore, this requirement is not met for shallow groundwater at NSGL to be classified as Class I.

### 4.3 35 IAC PART 620.210(a)(3) – SANDSTONE

Per 35 IAC Part 620.210(a)(3), Class I: Potable Resource Groundwater is groundwater 10 feet or more below the land surface and within "Sandstone which is 10 feet or more in thickness, or fractured carbonate which is 15 feet or more in thickness." The groundwater being evaluated at NSGL is in Quaternary sediments overlying the Silurian bedrock within the facility boundaries of NSGL and is situated on the level plain atop the bluff above the beach west of the shoreline along Lake Michigan at elevations of approximately 650 feet or higher. Therefore, this requirement is not met for shallow groundwater at NSGL to be classified as Class I potable resource groundwater.

### 4.3 35 IAC PART 620.210(a)(4) – YIELD AND HYDRAULIC CONDUCTIVITY

Per 35 IAC Part 620.210(a)(4), Class I: Potable Resource Groundwater is groundwater 10 feet or more below the land surface and within "Any geologic material which is capable of a: A) sustained groundwater yield, from up to a 12 inch borehole, of 150 gallons per day or more from a thickness of 15 feet or less; or B) hydraulic conductivity of $1 \times 10^{-4}$ cm/sec or greater using one of the following test methods or its equivalent: i) permeameter; ii) slug test; or iii) pump test." Yield can be estimated from purging of monitoring wells for groundwater sampling. The maximum purge rate of monitoring wells at NSGL with minimal sustained drawdown observed was 360 milliliters per minute. Typically, purge rates are much lower (100 to 200 milliliters per minute), with drawdown observed. Based on a rate of 360 milliliters per minute, this yield is equivalent to 137 gallons per day. Therefore, this requirement is not met for shallow groundwater at NSGL to be classified as Class I.

Table 1 summarizes the hydraulic conductivity measurements for NSGL in wells and piezometers screened at least 10 feet bgs. The geometric mean hydraulic conductivity values on a facility-wide basis are $4.94 \times 10^{-5}$ cm/sec (mean of site means) to $7.20 \times 10^{-5}$ cm/sec (mean

of individual wells), depending on how the data are considered. Both estimates are less than $1 \times 10^{-4}$ cm/sec. Therefore, this requirement is not met for shallow groundwater at NSGL to be classified as Class I.

## 5.0 CONCLUSION AND RECOMMENDATION

Based on this evaluation, the groundwater at NSGL does not meet the requirements of 35 IAC Part 620.210 as Class I. Additionally, groundwater at NSGL and in the surrounding area is not considered potable or is already classified as Class II. The groundwater within the limits of North Chicago is expressly prohibited from being used by city ordinance (North Chicago Code of Ordinances, Title 11, Chapter 7, Section 11-7-2 Prohibition) (except for uses in existence prior to the effective date of the ordinance). Groundwater at UST Site 5 (Old Gas Station Building 1600A) at NSGL and groundwater at Fort Sheridan, located approximately 5 miles south of NSGL and situated in similar physiographic, geologic, and hydrogeologic conditions, have been reclassified as Class II General Resource Groundwater. Therefore, shallow groundwater in Quaternary sediments overlying Silurian bedrock within NSGL and situated on the level plain atop the bluff west of the shoreline along Lake Michigan at elevations of approximately 650 feet or higher should be considered eligible for reclassification as Class II: General Resource Groundwater. This area is shown in Figure 2.

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TABLE 1

SUMMARY OF HYDRAULIC CONDUTIVITY VALUES
NAVAL STATION GREAT LAKES, ILLINOIS


| WELL ID | SCREENED INTERVAL (feet bgs) | AVERAGE WELL HYDRAULIC CONDUCTIVITY (K)[1] | |
|---|---|---|---|
| | | (feet/day) | (cm/sec) |
| **SITE 1 - GOLF COURSE LANDFILL** | | | |
| NTC01MW01 | 5-15 | 1.37E+00 | 4.84E-04 |
| NTC01MW02 | 29-39 | 2.53E+00 | 8.92E-04 |
| NTC01MW04 | 17-27 | 1.97E-01 | 6.95E-05 |
| NTC01MW05 | 4-14 | 2.96E-01 | 1.05E-04 |
| NTC01MW07 | 28-38 | 4.14E+00 | 1.46E-03 |
| NTC01MW08 | 7-17 | 3.61E-01 | 1.27E-04 |
| NTC01MW10 | 11-21 | 4.93E+00 | 1.74E-03 |
| | **Geometric Mean** | **1.06E+00** | **3.73E-04** |
| **SITE 2 - FORRESTAL LANDFILL** | | | |
| FL-01 | 10-50 | 6.74E-03 | 2.38E-06 |
| FL-02 | 10-50 | 4.81E-03 | 1.70E-06 |
| FL-04 | 10-50 | 1.95E-01 | 6.87E-05 |
| | **Geometric Mean** | **3.06E-02** | **1.08E-05** |
| **SITE 3 - SUPPLYSIDE LANDFILL** | | | |
| SL-01 | 10-50 | 3.79E+00 | 1.34E-03 |
| SL-03 | 10-50 | 3.65E-01 | 1.29E-04 |
| SL-04 | 10-50 | 8.95E+00 | 3.16E-03 |
| | **Geometric Mean** | **2.31E+00** | **8.16E-04** |
| **SITE 4 - FIRE FIGHTING TRAINING UNIT** | | | |
| MW-30-98 | 6-16 | 8.39E+00[2] | 2.96E-03[2] |
| MW-41-98 | 3-12 | 2.64E+01[2] | 9.30E-03[2] |
| | **Geometric Mean** | **1.49E+01[2]** | **5.25E-03[2]** |
| **SITE 5 - TRANSFORMER STORAGE BONEYARD** | | | |
| NTC05MW01 | 3.1-13.1 | 2.75E+00 | 9.70E-04 |
| NTC05MW03 | 4-14 | 3.26E+00 | 1.15E-03 |
| NTC05MW04 | 2.5-12.5 | 2.60E+00 | 9.18E-04 |
| NTC05MW05 | 6.5-16.5 | 2.53E+00 | 8.91E-04 |
| | **Geometric Mean** | **2.77E+00** | **9.77E-04** |
| **SITE 7 - RTC SILK SCREENING SHOP** | | | |
| NTC07MW01 | 9-19 | 3.98E-01 | 1.40E-04 |
| NTC07MW02 | 8-18 | 6.69E-02 | 2.36E-05 |
| NTC07MW05 | 9.5-19.5 | 1.93E-03 | 6.79E-07 |
| NTC07MW06 | 9-19 | 4.30E+00 | 1.52E-03 |
| NTC07MW07 | 7-17 | 3.49E+00 | 1.23E-03 |
| NTC07MW08 | 8-18 | 2.04E-01 | 7.20E-05 |
| | **Geometric Mean** | **2.32E-01** | **8.19E-05** |
| **SITE 9 - CAMP MOFFETT DISPOSAL AREA** | | | |
| NTC9-MW-01 | 4-14 | 4.16E+00 | 1.47E-03 |
| NTC9-MW-04 | 12-22 | 5.44E-01 | 1.92E-04 |
| NTC9-MW-05 | 8-18 | 1.50E+00 | 5.30E-04 |
| NTC9-MW-08 | 20-20 | 5.35E-01 | 1.89E-04 |
| | **Geometric Mean** | **1.16E+00** | **4.10E-04** |

TABLE 1

SUMMARY OF HYDRAULIC CONDUTIVITY VALUES
NAVAL STATION GREAT LAKES, ILLINOIS


| WELL ID | SCREENED INTERVAL (feet bgs) | AVERAGE WELL HYDRAULIC CONDUCTIVITY (K)[1] | |
|---|---|---|---|
| | | (feet/day) | (cm/sec) |
| **SITE 19 - FORMER INDOOR SHOOTING RANGE** | | | |
| NTC19MW01 | 5.5-15.5 | 1.79E+00 | 6.31E-04 |
| | **Geometric Mean** | **1.79E+00** | **6.31E-04** |
| **SITE 21 - BUILDING 1517 LANDFILL** | | | |
| NTC21-MW-01 | 4-14 | 1.36E+00 | 4.79E-04 |
| NTC21-MW-02 | 6-16 | 4.05E-01 | 1.43E-04 |
| NTC21-MW-05 | 3-13 | 8.14E-01 | 2.87E-04 |
| NTC21-MW-06 | 4-14 | 8.02E-01 | 2.83E-04 |
| | **Geometric Mean** | **7.74E-01** | **2.73E-04** |
| **SITE 22 - OLD DRY CLEANER FACILITY** | | | |
| NTC22MW01S | 10-20 | 2.48E-03 | 8.75E-07 |
| NTC22MW02S | 10-20 | 4.05E-01 | 1.43E-04 |
| NTC22MW03S | 14-24 | 5.03E-02 | 1.77E-05 |
| NTC22MW05S | 14-24 | 3.22E+00 | 1.14E-03 |
| NTC22MW07S | 10-20 | 6.28E-02 | 2.22E-05 |
| NTC22MW07D | 40-50 | 6.65E-01 | 2.34E-04 |
| NTC22MW08S | 14-24 | 2.69E-01 | 9.47E-05 |
| NTC22MW10S | 33-35 | 4.63E+01 | 1.63E-02 |
| NTC22MW10D | 37-40 | 1.27E+02 | 4.46E-02 |
| | **Geometric Mean** | **6.04E-01** | **2.13E-04** |
| **MAINSIDE** | | | |
| P-82 | 9.5-12 | 1.41E-02 | 4.99E-06 |
| P-85 | 8.8-12 | 3.94E-04 | 1.39E-07 |
| P-88 | 12-19 | 4.96E-03 | 1.75E-06 |
| | **Geometric Mean** | **3.02E-03** | **1.07E-06** |
| **FORRESTAL VILLAGE** | | | |
| P-91 | 11-16.7 | 1.34E-02 | 4.72E-06 |
| | **Geometric Mean** | **1.34E-02** | **2.24E-06** |
| **HALSEY VILLAGE** | | | |
| P-72 | 10.5-13 | 5.19E-05 | 1.83E-08 |
| | **Geometric Mean** | **5.19E-05** | **2.03E-07** |
| **BUILDING 1600A** | | | |
| MW-01 | 9.5-12 | 1.72E-03 | 6.07E-07 |
| MW-02 | 8.8-12 | 2.98E-03 | 1.05E-06 |
| MW-03 | NA | 6.72E-03 | 2.37E-06 |
| MW-04 | NA | 2.43E-02 | 8.57E-06 |
| MW-05 | 12-19 | 2.20E+00 | 7.76E-04 |
| MW-06 | 12-19 | 4.28E-02 | 1.51E-05 |
| MW-07 | 12-19 | 2.48E-02 | 8.75E-06 |
| MW-08 | 12-19 | 1.21E-02 | 4.26E-06 |
| MW-09 | 12-19 | 1.85E-03 | 6.53E-07 |
| | **Geometric Mean** | **1.52E-02** | **5.37E-06** |
| **OVERALL GEOMETRIC MEAN:** | **SITE BASIS** | **1.23E-01** | **4.94E-05** |
| | **INDIVIDUAL WELL BASIS** | **2.04E-01** | **7.20E-05** |

## TABLE 1

## SUMMARY OF HYDRAULIC CONDUTIVITY VALUES
## NAVAL STATION GREAT LAKES, ILLINOIS


**Notes**

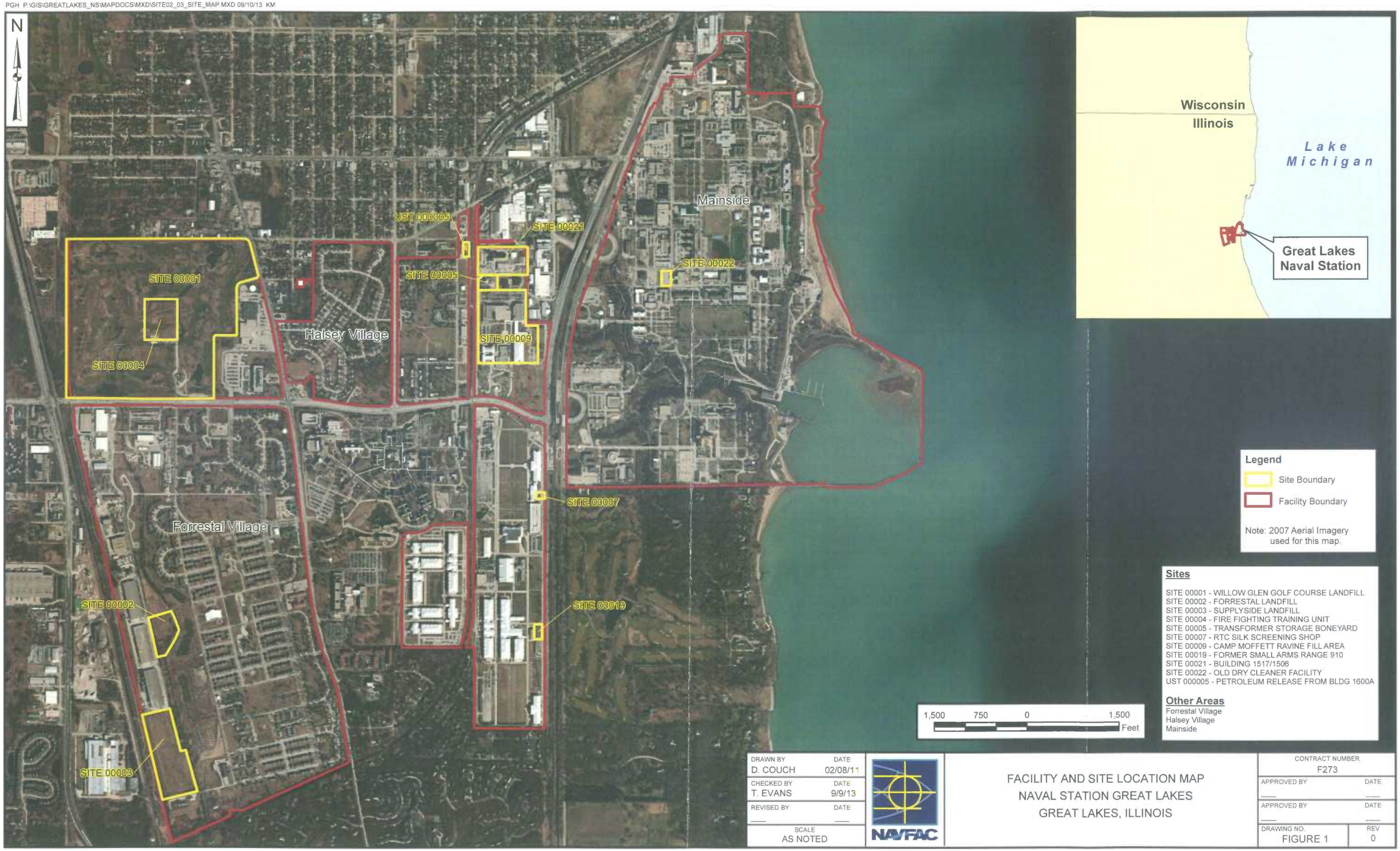
(1) Average well K value based on arithmetic mean of K values for each well.

(2) Value excluded from geometric mean because well is screened in fill material.

Well locations shown on Figure 3.

bgs = below ground surface
cm/sec = centimeters per second
NA = information not available

PGH P:\GIS\GREATLAKES_NS\MAPDOCS\MXD\SITE02_03_SITE_MAP.MXD 09/10/13 KM




**Sites**

SITE 00001 - WILLOW GLEN GOLF COURSE LANDFILL
SITE 00002 - FORRESTAL LANDFILL
SITE 00003 - SUPPLYSIDE LANDFILL
SITE 00004 - FIRE FIGHTING TRAINING UNIT
SITE 00005 - TRANSFORMER STORAGE BONEYARD
SITE 00007 - RTC SILK SCREENING SHOP
SITE 00009 - CAMP MOFFETT RAVINE FILL AREA
SITE 00019 - FORMER SMALL ARMS RANGE 910
SITE 00021 - BUILDING 1517/1506
SITE 00022 - OLD DRY CLEANER FACILITY
UST 000005 - PETROLEUM RELEASE FROM BLDG 1600A

**Other Areas**

Forrestal Village
Halsey Village
Mainside

| | |
|---|---|
| DRAWN BY: D. COUCH | DATE: 02/08/11 |
| CHECKED BY: T. EVANS | DATE: 9/9/13 |
| REVISED BY: ___ | DATE: ___ |
| SCALE: AS NOTED | |

NAVFAC

# FACILITY AND SITE LOCATION MAP
# NAVAL STATION GREAT LAKES
# GREAT LAKES, ILLINOIS

| | |
|---|---|
| CONTRACT NUMBER: F273 | |
| APPROVED BY: ___ | DATE: ___ |
| APPROVED BY: ___ | DATE: ___ |
| DRAWING NO.: FIGURE 1 | REV: 0 |

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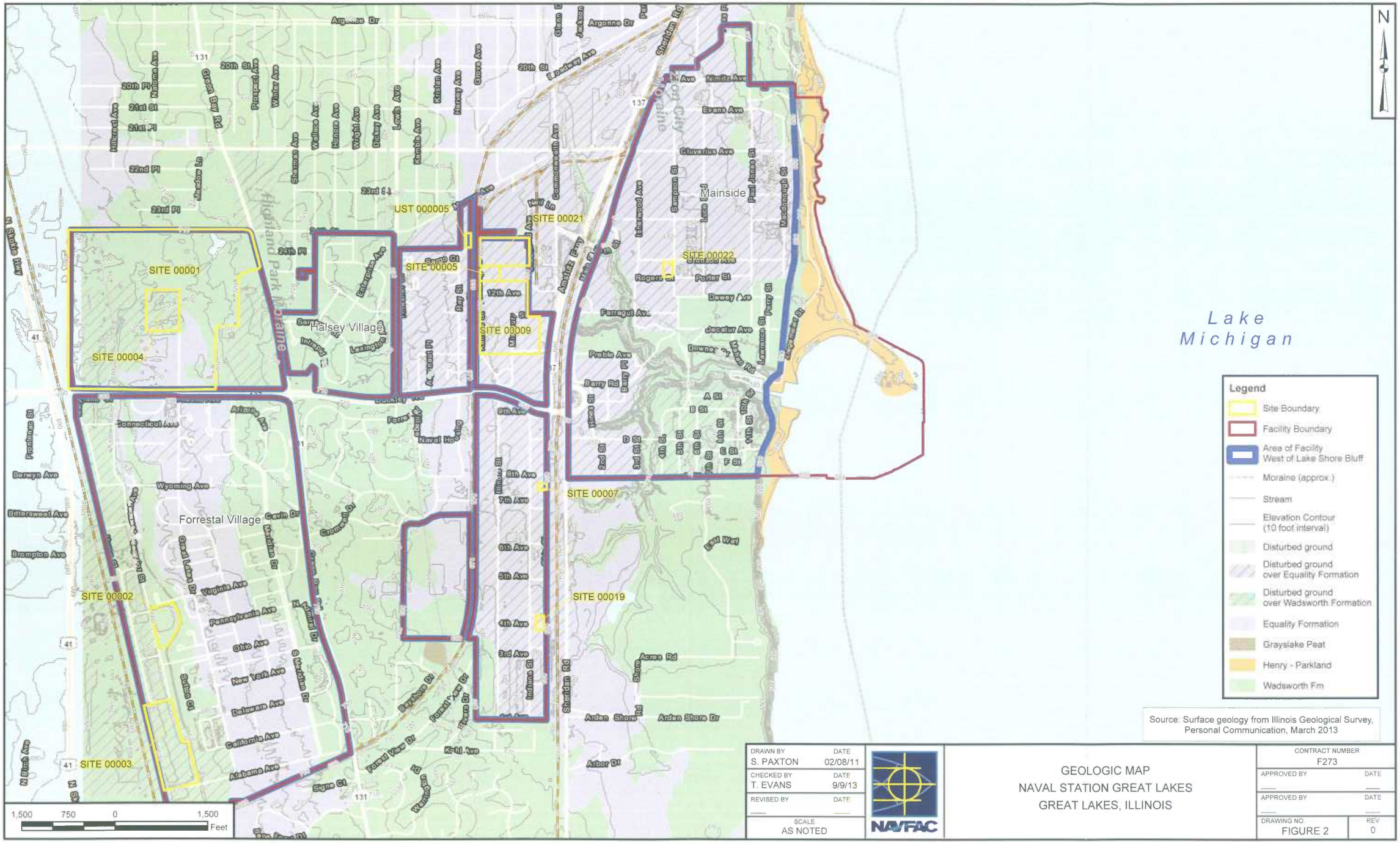



Source: Surface geology from Illinois Geological Survey, Personal Communication, March 2013

| | | | |
|---|---|---|---|
| DRAWN BY S. PAXTON | DATE 02/08/11 | GEOLOGIC MAP<br>NAVAL STATION GREAT LAKES<br>GREAT LAKES, ILLINOIS | CONTRACT NUMBER F273 |
| CHECKED BY T. EVANS | DATE 9/9/13 | | APPROVED BY / DATE |
| REVISED BY | DATE | | APPROVED BY / DATE |
| SCALE AS NOTED | | NAVFAC | DRAWING NO. FIGURE 2 / REV 0 |

PGH P:\GIS\GREATLAKES_NS\MAPDOCS\MXD\HYDRAULIC_CONDUCTIVITY_TEST_MAP.MXD 09/10/13 KM

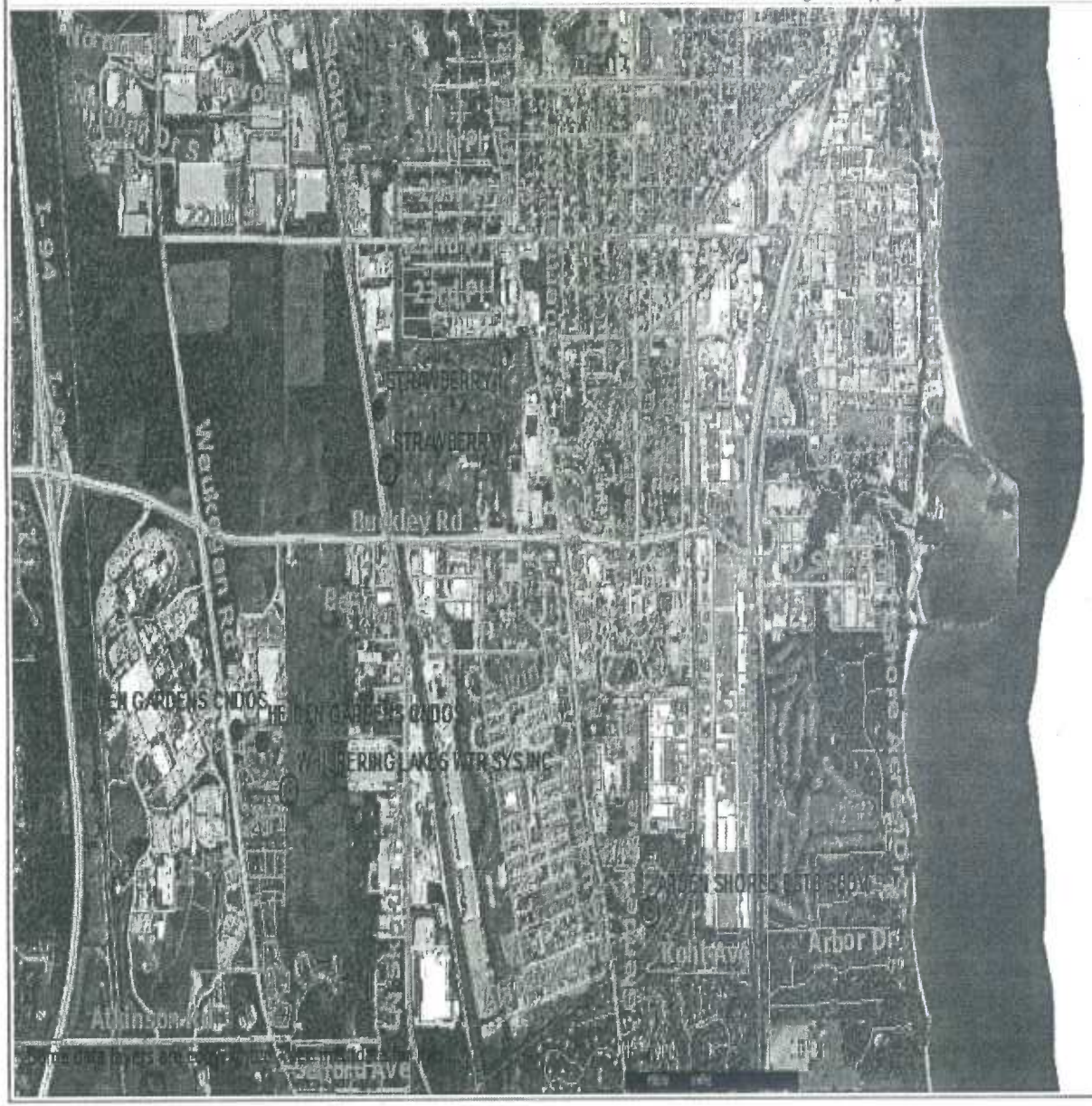

| | |
|---|---|
| DRAWN BY D. COUCH | DATE 03/21/13 |
| CHECKED BY T. EVANS | DATE 9/9/13 |
| T. EVANS | DATE |
| SCALE AS NOTED | |

NAVFAC

# HYDRAULIC CONDUCTIVITY TEST LOCATION MAP NAVAL STATION GREAT LAKES GREAT LAKES, ILLINOIS

| | |
|---|---|
| CONTRACT NUMBER F273 | CTO NUMBER |
| APPROVED BY | DATE |
| APPROVED BY | DATE |
| FIGURE NO. FIGURE 3 | REV 0 |

Resource Management Mapping Service




- Community Water Supply - Wells
- Streets and Roads 2010
- CWS Regulated Recharge Areas
- CWS Phase II Wellhead Protection Area

Map Scale = 1:35768

Illinois Environmental Protection Agency

# Source Water Assessment Program Factsheets

**Select Water System Type**

Community

**Select County**

Lake

Search County

-- Or --

**Enter any part of a Facility Name**

Arden Shores

Search Facility Name

**Search Results**

LAKE CO. PW - ARDEN SHORES ESTATES

Select Water System

To view a summary version of the completed Source Water Assessments, you may search our records by county or public water supply name. This summary information describes pertinent sub-sections of each completed assessment including: Importance of Source Water; Susceptibility to Contamination Determination; and documentation/recommendation of Source Water Protection Efforts. However, summaries of Source Water Protection Efforts have not been documented for non-community water supplies. It should be noted that these Source Water Assessment summaries are presented in strict compliance with Illinois EPA's security policy on the release of sensitive information. Therefore, all locational data and maps pertaining to wells, aquifers and/or surface water intakes have been removed. To obtain a complete version of the Source Water Assessment Report, please contact your local water supply officials.

## Water Percentages:

| Surface Water % | Surface Water Purchase % | Ground Water % | Ground Water Purchase % | Ground Water UDI % | Ground Water UDI Purchase % |
|---|---|---|---|---|---|
| 0.00 | 0.00 | 100.00 | 0.00 | 0.00 | 0.00 |

## Importance Of Source Water:

The Arden Shores Estates Subdivision (Facility Number 0975050) obtains its water from one active community water supply well. Well #1 (Illinois EPA #20267) supplies an average of 4,257 gallons per day (gpd) to 22 services or an estimated population of 66.

## Source Of Water Supply:

Well #1 is located in Lake Bluff, southeast of the Great Lakes Naval Training Center. It produces 15 gallons per minute (gpm) and is operated for a maximum output of roughly 10,343 gpd. Well #1 is 283 feet in depth. The well obtains its source water from a shallow bedrock aquifer overlain by materials of low permeability. Permeability is a measure of the capability of a soil or sediment to transmit fluids. The Illinois EPA does not consider this well to be geologically sensitive.

## Well Data For This Facility:

| Well ID | Well Description | Status | Depth | Minimum Setback | Pumpage | Aquifer Code | Aquifer Description | Max Zone |
|---|---|---|---|---|---|---|---|---|
| WL20267 | WELL 1 (20267) | A | 283.00 | 200 | 1469200 | 5050 | Shallow Bedrock | 0 |

## Intake Details:

| No Data |
|---|

## Source Water Quality:

Arden Shores Estates Subdivision's well has been sampled since October 25, 1991 for inorganic chemicals (IOC) as part of a Statewide Groundwater Monitoring Program. However, the well has not been sampled for volatile organic compounds (VOC) and synthetic organic compounds (SOC). IOC analyses indicate that concentrations of these chemicals are consistent with other shallow bedrock aquifers of similar character (e.g., moderate to high mineralization) in this part of Illinois. It is important to note that the IOC results were below the groundwater quality standards established under 35 Illinois Administrative Code Part 620.410.

## Finished Water Quality:

As referenced in the Source Water Quality Section of this report, the Arden Shores Estates Subdivision has mineralized groundwater. Further information on finished water quality data tables of monitored parameters, contaminants detected, health advisory information, drinking water standards and maximum contaminant levels are available at http://www.epa.gov/ogwdw/. Similar information is also available in the Consumer Confidence Report supplied by the Arden Shores Estates Subdivision to their customers.

## Potential Sources Of Contamination:

There are no potential sources of contamination identified for Arden Shores Estates Subdivision's well. These "potential" sources, when identified, are labeled on the Wellhead Protection Planning Map and described in the following tables. (Maps and tables are not available in the Visually Impaired Accessible version. However, the information presented in the maps and tables is summarized within the following text sections of this fact sheet.) These sites are predominantly identified through the Illinois EPA's Well Site Survey program based on the nature of their activity, the availability of data in electronic databases, and their geographic proximity to the source water protection area. In addition, the Illinois EPA made use of the information from its leaking underground storage tank database (http://epadata.epa.state.il.us/land/ust/search.asp) and site remediation program database (http://epadata.epa.state.il.us/land/srp/search.asp) to further assess potential sources of contamination to the subdivision's source water. These databases include information from the Illinois EPA Division of Land Pollution Control (LPC) and the Illinois Emergency Management Agency (IEMA). The following is a list of facilities contained within these databases. As a result of multiple possible contamination sources, individual sites may be listed in the table more than once in relation to a well.

IEMA # Site Name Street City ZIP Code
20010138 Great Lakes Naval Training Ctr. 201 Decatur Ave., Bldg. 1A Great Lakes 60088
20011971 Great Lakes Naval Training Center 201 Decatur Ave., Bldg. 3216B Great Lakes 60088

903223 Naval Training Center Bldg. 239 Great Lakes 60088
903584 Naval Training Center Bldg. 16001, Ray St. Great Lakes 60088
903585 Naval Training Center Bldg. 3402 Great Lakes 60088
910173 U.S. Naval Training Ctr. Bldg. #144 Great Lakes 60088
910497 Naval Training Center Bldg. 2710 Great Lakes 60088
911218 Naval Training Center Hold 238 Great Lakes 60088
911532 Naval Training Center Bldg. 325 Great Lakes 60088
921542 Naval Training Center Bldg. 5 Great Lakes 60088
922928 Naval Training Center Bldg. 329 Great Lakes 60088
922929 Naval Training Center Bldg. 2710 Great Lakes 60088
922930 Naval Training Center Bldg. 3216B Great Lakes 60088
922931 Naval Training Center Bldg. 324 Great Lakes 60088
931477 Naval Training Center Meridian Rd., Bldg. 2710 Great Lakes 60088
933115 Naval Training Center Bldg. 144 Great Lakes 60088
933116 Naval Training Center Naval Training Center, Bldg. 106 Great Lakes 60088
933218 Naval Training Center Bldg. 3216 Great Lakes 60088
940229 Naval Training Center Bldg. #13 Great Lakes 60088
940230 Naval Training Center Bldg. 3400 Great Lakes 60088
940396 Naval Training Center Bldg. 1 Great Lakes 60088
942674 Naval Training Center Bldg. 3511 Great Lakes 60088
951914 Naval Training Center Bldg. 11 Great Lakes 60088
971363 Great Lakes Naval Training Ctr. 2912 Meridian Rd. Great Lakes 60088
971739 U.S. Navy 5703 Sheridan Rd. Great Lakes 60088
971912 U.S. Navy Great Lakes Bldg. 11 Great Lakes 60088
990458 Great Lakes Naval Training Center Bldg. 229, Isherwood Ave. Great Lakes 60088-5600
990527 Dept. of the Navy 201 Decatur Ave., Bldg. 1A Great Lakes 60088-5600
990712 U.S. Navy Bldg. #329, Sampson St. Great Lakes 60088
991045 Dept. of the Navy 324 Isherwood Ave. Great Lakes 60088
991563 Dept. of the Navy Bldg. 68H on C St. Great Lakes 60088
992703 Dept. of the Navy 3216B Mississippi St. Great Lakes 60088
20000161 LBHC Assoc., Ltd. 700 Jenkisson Ave. Lake Bluff 60044
20000987 Knauz Motors, Inc. 775 Rockland Rd. Lake Bluff 60044
20000989 W.K. Developers, Inc. 500 Arden Shore Rd. Lake Bluff 60044
20010322 Exxon Mobil 2 North Waukegan Rd. Lake Bluff 60044
20020750 Hilton Hotel Corp. 136 Green Gay Rd. Lake Bluff 60044
20021531 J & L Oil 218 Waukegan Rd. Lake Bluff 60044
860928 National Automotive 1300 Skokie Hwy. Lake Bluff 60044
891352 Shriners Hospital for Cripple 29855 Hwy. 41 Lake Bluff 60044
891677 Mobil Oil #05BCB 2 North Waukegan Rd. & Rockland Lake Bluff 60044
891899 North Shore Waste Control 109 Skokie Hwy. Lake Bluff 60044
891990 Central Lake County Joint Action 300 Rockland Rd. Lake Bluff 60044
892319 Gold Star Chemical 915 Sherwood Rd. Lake Bluff 60044
892668 Shepard Chevy 930 Carriage Ln. Lake Bluff 60044
900196 North Shore Waste Control 105 Skokie Valley Rd. Lake Bluff 60044
900479 North Shore Waste Control Hwy. 176 East of Hwy. 141 Lake Bluff 60044
910995 Shore Acres 1601 Shore Acres Rd. Lake Bluff 60044
912053 U.S. Postal Service 26 East Grant Ave. Lake Bluff 60044
921972 Bassett, Alyce M. 20 North Skokie Lake Bluff 60044
930274 D.B.A. Prod. Co. Inc. 22 Skokie Hwy. Lake Bluff 60044
931599 North Shore Auto Service 545 Rockland Rd. Lake Bluff 60044
941881 Meyer Material Co. 30285 North Skokie Hwy. Lake Bluff 60044
951317 Johnson Fire Proof Door 415 Skokie Hwy. Lake Bluff 60044
952363 Mobil Oil Corp. 2 North Waukegan Rd. Lake Bluff 60044
961060 Presidents Baking Co. 1400 Skokie Hwy. Lake Bluff 60044
961518 Presidents Baking Co. 1400 Skokie Hwy. Lake Bluff 60044
961795 North Shore Auto Service 545 Rockland Ave. Lake Bluff 60044
980079 Arvidson, George 617 Sheridan Rd. Lake Bluff 60044
980214 Harlan, John 601 Sheridan Rd. Lake Bluff 60044
980222 Kinnucan Co. 28877 North Nagel Ct. Lake Bluff 60044
982548 Rondout Rockland Corp. 1261 Rockland Rd. Lake Bluff 60044

990419 Lake Bluff, Village of 105 Kohl Dr. Lake Bluff 60044
991475 Northshore Waste 725 Skokie Hwy. (105-109 Skokie Valley) Lake Bluff 60044

| LPC# | Site Name | Street | City | ZIP Code |
|---|---|---|---|---|
| 0970755005 | Chemical Ways | 921 Sherwood Drive | Lake Bluff | 60044- |
| 0970755016 | DBA Products Company | One Sherwood Terrace | Lake Bluff | 60044- |
| 0970755010 | Rosos Chemical Company | 990 North Shore Drive | Lake Bluff | 60044- |

## Site Data For This Facility:

No Data

## Susceptibility To Contamination:

To determine Arden Shores Estates Subdivision's susceptibility to groundwater contamination, the following document was reviewed: a Well Site Survey, published in 1993 by the Illinois EPA. Based on the information obtained in this document, there are no potential sources of groundwater contamination that could pose a hazard to groundwater utilized by Arden Shores Estates Subdivision's Community Water Supply. However, information provided by the Leaking Underground Storage Tank and Remedial Project Management Sections of the Illinois EPA indicated sites with on-going remediation that might be of concern. The susceptibility determination for this community water supply is based on a number of criteria including monitoring conducted at the well, monitoring conducted at the entry point to the distribution system, and available hydrogeologic data on the well. The Illinois EPA has determined that the Arden Shores Estates Subdivision Community Water Supply's source water is not susceptible to contamination. The land use within the wellhead protection area was analyzed as part of this susceptibility determination. This land use includes residential properties.

## Source Water Protection Efforts:

The Illinois Environmental Protection Act provides a minimum protection zone of 200 feet for Arden Shores Estates Subdivision's well. This minimum protection zone is regulated by the Illinois EPA. To further reduce the risk to the source water, a maximum protection zone may be established, which is authorized by the Illinois Environmental Protection Act and allows county and municipal officials the opportunity to provide additional potential source prohibitions up to 1,000 feet from their wells. To further minimize the risk to the subdivision's groundwater supply, the Illinois EPA recommends the following additional activities be considered. First, the water supply staff is encouraged to review their cross connection control ordinance to ensure that it remains current and viable. Cross connections to either the water treatment plant (for example, at bulk water loading stations) or in the distribution system may negate all source water protection initiatives. Second, the water supply staff may wish to conduct contingency planning. Contingency planning documents are a primary means to ensure that, through emergency preparedness, a community will minimize their risk of being without safe or adequate water. Finally, the facility has only one source of water. The Illinois EPA recommends that a second water supply well, or an automatic interconnection with a neighboring supply should be provided to maintain the utility when well #1 is out of service (Section 3.2.1.2 of the Recommended Standards for Water Works). To further reduce the risk to source water, the Arden Shores Estates Subdivision has implemented a wellhead protection program, which includes the proper abandonment of potential routes of groundwater contamination within the wellhead protection area and correction of any sanitary defects that might be present at the water treatment facility. This effort has resulted in the community water supply receiving a special exception permit from the Illinois EPA, which allows a reduction in monitoring and laboratory analysis costs.



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Illinois Environmental Protection Agency

# Source Water Assessment Program Factsheets

**Select Water System Type**

Community

**Select County**

Lake

Search County

-- Or --

**Enter any part of a Facility Name**

Strawberry

Search Facility Name

**Search Results**

STRAWBERRY 1

Select Water System

To view a summary version of the completed Source Water Assessments, you may search our records by county or public water supply name. This summary information describes pertinent sub-sections of each completed assessment including: Importance of Source Water; Susceptibility to Contamination Determination; and documentation/recommendation of Source Water Protection Efforts. However, summaries of Source Water Protection Efforts have not been documented for non-community water supplies. It should be noted that these Source Water Assessment summaries are presented in strict compliance with Illinois EPA's security policy on the release of sensitive information. Therefore, all locational data and maps pertaining to wells, aquifers and/or surface water intakes have been removed. To obtain a complete version of the Source Water Assessment Report, please contact your local water supply officials.

## Water Percentages:

| Surface Water % | Surface Water Purchase % | Ground Water % | Ground Water Purchase % | Ground Water UDI % | Ground Water UDI Purchase % |
|---|---|---|---|---|---|
| 0.00 | 100.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## Importance Of Source Water:

## Source Of Water Supply:

## Well Data For This Facility:

| Well ID | Well Description | Status | Depth | Minimum Setback | Pumpage | Aquifer Code | Aquifer Description | Max Zone |
|---|---|---|---|---|---|---|---|---|
| WL00816 | WELL 1 W OF FRONTENAC S OF BARRY | I | 0.00 | 200 | -1 | 5050 | Shallow Bedrock | 0 |
| WL00817 | WELL 2 W OF FRONTENAC N OF BERWYN | I | 0.00 | 200 | 0 | 5050 | Shallow Bedrock | 0 |

## Intake Details:

No Data

## Source Water Quality:

## Finished Water Quality:

## Potential Sources Of Contamination:

## Site Data For This Facility:

No Data

## Susceptibility To Contamination:

## Source Water Protection Efforts:



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Illinois Environmental Protection Agency

# Source Water Assessment Program Factsheets

**Select Water System Type**

Community

**Select County**

Lake

Search County

-- Or --

**Enter any part of a Facility Name**

Whispering

Search Facility Name

**Search Results**

WHISPERING LAKES WATER SYSTEM, INC.

Select Water System

To view a summary version of the completed Source Water Assessments, you may search our records by county or public water supply name. This summary information describes pertinent sub-sections of each completed assessment including: Importance of Source Water; Susceptibility to Contamination Determination; and documentation/recommendation of Source Water Protection Efforts. However, summaries of Source Water Protection Efforts have not been documented for non-community water supplies. It should be noted that these Source Water Assessment summaries are presented in strict compliance with Illinois EPA's security policy on the release of sensitive information. Therefore, all locational data and maps pertaining to wells, aquifers and/or surface water intakes have been removed. To obtain a complete version of the Source Water Assessment Report, please contact your local water supply officials.

## Water Percentages:

| Surface Water % | Surface Water Purchase % | Ground Water % | Ground Water Purchase % | Ground Water UDI % | Ground Water UDI Purchase % |
|---|---|---|---|---|---|
| 0.00 | 0.00 | 100.00 | 0.00 | 0.00 | 0.00 |

## Importance Of Source Water:

Whispering Lakes Water System, Incorporated (Facility Number 0970220) utilizes one community water supply well. Well #1 (Illinois EPA #00704) supplies 16,300 gallons per day to an estimated population of 375 individuals at 125 service connections.

## Source Of Water Supply:

Whispering Lakes Water System's well is 1,100 feet deep and is located approximately 300 feet from building #4 of the Condominium Complex on Heiden Circle. This well pumps 90 gallons per minute from a deep bedrock aquifer overlain by uniform, relatively impermeable silty or clayey till, with no evidence of interbedded sand and gravel. Permeability is a measure of the ability of a soil or sediment to transmit fluids. The Illinois EPA does not consider this well geologically sensitive.

## Well Data For This Facility:

| Well ID | Well Description | Status | Depth | Minimum Setback | Pumpage | Aquifer Code | Aquifer Description | Max Zone |
|---|---|---|---|---|---|---|---|---|
| WL00704 | WELL 1 (00704) | A | 1100.00 | 200 | 2710900 | 6366 | Deep Bedrock | 0 |

## Intake Details:

No Data

## Source Water Quality:

This well has not been sampled by Illinois EPA staff. Illinois EPA will schedule to conduct sampling for this well in the future. Information concerning inorganic chemicals (IOC) in source water provided in a U.S. Geological Survey report, "The Groundwater Atlas of the United States, Segment 10 (730-K)," which provides a discussion of the background levels for some inorganic chemicals in Illinois aquifers.

## Finished Water Quality:

Further information on Finished Water Quality, including data tables of monitored parameters, contaminants detected, health advisory information, drinking water standards, and maximum contaminant levels, is available at (http://www.epa.gov/ogwdw/). Similar information is also available in the Consumer Confidence Report supplied by Whispering Lakes Water System to its customers.

## Potential Sources Of Contamination:

The sites labeled on the Wellhead Protection Planning Map and described in the following tables are considered "potential" sources of contamination. (Maps and tables are not available in the Visual Impairment Accessible version. However, information included in the maps and tables are summarized within the following text sections of this fact sheet.) These sites were predominantly identified through the Illinois EPA's Well Site Survey Program based on the nature of their activity, the availability of data in electronic databases, and their geographic proximity to the source water protection area. In addition, the Illinois EPA made use of the information from its leaking underground storage tank database (http://epadata.epa.state.il.us/land/ust/search.asp) and site remediation program database (http://epadata.epa.state.il.us/land/srp/search.asp) to further assess potential sources of contamination to the water source. These databases include information from the Illinois EPA Division of Land Pollution Control (LPC) and the Illinois Emergency Management Agency (IEMA). A search of these databases revealed no additional potential contamination sources near the survey area.

## Site Data For This Facility:

| Well ID | Site/GMZ ID | Map Code | Name | Distance | Status |
|---|---|---|---|---|---|
| WL00704 | 000013886 | 007C | ABBOTT LABORATORIES | 2450 | A |
| WL00704 | 000013887 | 007C | LIQUID CONTROLS CORP. | 1560 | A |

| | | | | | |
|---|---|---|---|---|---|
| WL00704 | 000013888 | 007C | AMMCO TOOLS INC. | 1100 | A |
| WL00704 | 000013889 | 007C | HEIDEN GARDEN CONDOS | 800 | B |

## Susceptibility To Contamination:

To determine Whispering Lake's susceptibility to groundwater contamination, information obtained during a Well Site Survey performed by the Illinois Rural Water Association on August 18, 1999 was reviewed. Based on this information, four potential sources of contamination were identified within proximity of this water supply's well. Based on information provided by Whispering Lakes water supply officials, the following facilities, also indicated as potential sources in the site data table, have changed their status since the time of the well site survey: Ammco Tools Inc. (business no longer active, property now owned by Abbott Laboratories); Liquid Controls Corp. (business no longer active, property now owned by Abbott Laboratories); and Heiden Gardens Condos (well has been properly abandoned)." The Illinois EPA does not consider the source water susceptible to contamination. This determination is based on a number of criteria including: monitoring conducted at the well; monitoring conducted at the entry point to the distribution system; and the available hydrogeologic data on the well. In anticipation of the U.S. EPA's proposed Ground Water Rule, the Illinois EPA has determined that the water supply is not vulnerable to viral contamination. This determination is based upon the completed evaluation of the following criteria during the Vulnerability Waiver Process: the well is properly constructed with sound integrity and proper site conditions; a hydrogeologic barrier exists that should prevent pathogen movement; all potential routes and sanitary defects have been mitigated such that the source water is adequately protected; monitoring data did not indicate a history of disease outbreak; and a sanitary survey of the water supply did not indicate a viral contamination threat. Because the well is constructed in a confined aquifer, which should minimize the movement of pathogens into the well, well hydraulics were not considered to be a significant factor in the vulnerability determination. Hence, well hydraulics were not evaluated for this groundwater supply.

## Source Water Protection Efforts:

The Illinois Environmental Protection Act provides a minimum protection zone of 200 feet for Whispering Lakes Water System's well. This minimum protection zone is regulated by the Illinois EPA. To further minimize the risk to the facility's groundwater supply, the Illinois EPA recommends that three additional activities be assessed. First, the facility may wish to petition Lake County enact a "maximum setback zone" ordinance. These ordinances are authorized by the Illinois Environmental Protection Act and allow county and municipal officials the opportunity to provide additional protection up to 1,000 feet from their wells. Second, the water supply staff may wish to revisit their contingency planning documents. Contingency planning documents are a primary means to ensure that, through emergency preparedness, a water supply will minimize their risk of being without safe and adequate water. Finally, the water supply staff is encouraged to review their cross connection control program to ensure it remains current and viable. Cross connections to either the water treatment plant (for example, at bulk water loading stations) or in the distribution system may negate all source water protection initiatives provided by the facility.



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